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THE INFLUENCE
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VIVISECTION ON HUMAN SURGERY

BY

SAMPSON GAMGEE, F.R.S.E.

CONSULTING SURGEON TO THE QUEEN'S HOSPITAL;
VICE-PRESIDENT OF THE BIRMINGHAM MEDICAL INSTITUTE;
FELLOW OF THE ACADEMY OF MEDICINE OF ROME,
OF THE SOCIETY OF SURGERY OF PARIS,
AND OF THE MEDICAL SOCIETIES OF CHRISTIANIA AND OF BOSTON, MASSACHUSETTS.

"VERE SCIRE, EST PER CAUSAS SCIRE."—*Lord Bacon.*

LONDON :

J. AND A. CHURCHILL, NEW BURLINGTON STREET.

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NOTICE.

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SAMPSON GAMGEE.

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THE INFLUENCE OF VIVISECTION ON HUMAN SURGERY.

MR. PRESIDENT AND GENTLEMEN,

So long as a Society supported by the Lord Chief Justice of England and other persons of distinction, is untiring in its efforts to suppress vivisection, and to render amenable to criminal prosecution those who practise it, deep interest must attach to the question, what have scientific experiments on living animals done for the progress of Human Surgery?

I take for granted the purity of the intentions of those who so loudly denounce vivisection, and I intend no disrespect when I express a belief, that they would be a little more tolerant, if the extent and accuracy of their knowledge equalled the intensity of their zeal.

The anti-vivisectionists have directed so large a share of their attention to our distinguished brethren, who cultivate science and benefit mankind by special devotion to physiological research, that there is some danger of these scientists monopolizing the honour of martyrdom.

Since human surgery established any claim to be numbered amongst the sciences, its brightest ornaments and greatest practitioners, have been amongst the boldest and most indefatigable experimenters on living animals.

Without such experiments Scientific Surgery could not have been founded, and its present humane and safe practise would have been impossible.

To make good this statement in all its bearings would demand a review of the history of Surgery, and of those departments of Medical Science with which it is inseparably linked; but such a retrospect, at once comprehensive and impartial, is simply out of the question within the limits of an Address.

In support of the proposition I have laid down, time will only allow me to produce a few proofs. I vouch for their authenticity, and trust to your approving their cogency.

Let us glance at the state of Surgery in the middle of the last century, a date comparatively so recent, that the grandfathers of many of those I am addressing were then in ripe manhood.

The year 1750 is memorable for the death of Jean Louis Petit, whose name will always live in surgical dressing rooms with his tourniquet, and whom ripe students of our art revere as a master, scarcely second to Ambroise Paré. In that same year Haller, Morgagni and the french surgical Academicians were at their zenith, and William Cheselden, stricken with paralysis, left Chelsea Hospital,—happily not before he had well assured his brightest title to enduring fame.

It has been said of Sir Humphrey Davy that Michael Faraday was his greatest discovery; and so the master of lateral lithotomy did nothing greater, or more useful, than the first lessons in surgery which he imparted to John Hunter.

Born in 1728 John Hunter was 22 when he left Cheselden to enter as surgeon pupil at St. Bartholomew's, where Percival Pott, at 36 years of age, had been appointed to the full surgeoncy the preceding year. So that you see the epoch I have chosen was a golden one for surgical science

and art. For our present purpose it possesses another advantage. In 1750 appeared "A Critical Enquiry into the Present State of Surgery by Samuel Sharpe, F.R.S., Surgeon to Guy's Hospital,"—a work which supplies an authoritative standard of the state of surgical knowledge at that period.

Of the means for arresting hemorrhage after amputations, Mr. Sharpe says, "The actual cautery was certainly the most to be depended upon, and was therefore through a succession of ages down to our own days more frequently employed than any of the other means. . . . But the horror created by a red hot iron begat in some men an invincible antipathy to the method. Some surgeons applied arsenic and corrosive sublimate to the bleeding vessels, &c."

There is an account of "nineteen men who, *only one excepted*, all died after amputations, and, as it was supposed, chiefly from the poisonous quality of the sublimate."*

This was the state of surgery in 1750, 158 years after the death of Paré. He, it was, who revived the ancient practice of ligaturing blood vessels, but in such an imperfect manner as to exercise comparatively little influence. Dying in 1692, when William Harvey, a lad of 14, was scanning Latin verses in Canterbury Grammar School, the great Huguenot knew little or nothing of the circulation of the blood.

To tie an artery Paré transfixed the tissues from without, very much in the same fashion that an upholsterer quilts a mattress, or he included in the ligature muscular and other tissues, for the purpose of securing better hold.† His contemporary Fabricius ab Aquapendente, Harvey's teacher of anatomy, argues against the ligature of arteries, and prefers

*Sharpe of cit. p. 279-80.

† Œuvres complètes d'Ambroise Paré par J. F. Maélgaïne, tome 2, page 8, et 225.

the cautery for the arrest of hemorrhage. To amputate a breast he directs the employment of "a red hot knife, or a sharp knife made of horn, or wood dipped in aquafortis, by which artifice he supposes the vessels will be cauterized as the incision advances."

Jean Louis Petit relates, that when he commenced to practice surgery, (more than a century after Paré's death), it was deemed a matter of indifference by some surgeons to tie the nerve with the artery, while others particularly enjoined such combined ligature, and for this reason, "to retain the blood it was necessary to tie the vessels, and no less so to tie the nerves in order to retain the animal spirit."*

William Bromfield, surgeon to Her Majesty's household and to St. George's Hospital, wrote in 1773 in praise of Mr. White's use of the sponge to restrain the bleeding of the large blood vessels after amputation of the extremities, "for the pain consequent to enclosing the nerve within the ligature, can only be described by those who have felt it; indeed, the bystanders, as well as the operator, if not deaf and blind, must be impressed with an idea of the patient's suffering the most excruciating torture." † Further on the same author relates "two cases in which the patients died from hemorrhage after amputation of the thigh. The one had the vessels secured by the needle and ligature, with some muscular substance, &c., as usually enclosed." Such the state of practice, according to the most reputed text book published by one of the surgeons to St. George's Hospital, five years after John Hunter was appointed on its staff.

**Traité des maladies chirurgicales et des opérations qui leur conviennent*; ouvrage posthume de J. L. Petit, mis au jour par M. Lesne Nouvelle édition corrigée Paris 1790, tome 3, page 175.

†*Chirurgical Observations and Cases*, London, 1773, vol. 1, pp. 293 and 307.

It may give you a nearer and clearer perception of such barbarities, if I quote from a letter with which I have been favoured by our venerable brother Mr. Thomas Taylor, whose presence amongst us to-day is, I am sure, matter of general congratulation. Mr. Taylor, a pupil of Abernethy, had an uncle, his namesake, who was appointed apothecary to our General Hospital in 1785. From him he often heard of the horrors of amputation scenes,—dressers watching by the patient day and night, with buttons of lint dipped in flour on a plate, ready for application to any bleeding point that might appear.

Reflect on such a scene, and on the experiences of Petit and Bromfield, as surgical realities in the second half of the last century.

Happily a brighter era was dawning. Constituted under the leadership of Lapeyronie in 1731, the French surgical academicians were the chief glory and mainstay of scientific Surgery in the pre-Hunterian epoch. It is of their memoirs that Sir Benjamin Brodie said “There is no richer mine of surgical knowledge than that which is contained in the memoirs of the French Academy of Surgery.”* To quote very briefly from their preface “There are two sources whence flow the truths which can enrich our art, clinical observation and experimental physics. . . The plan which the Academy proposes to itself is to raise Surgery on the basis of clinical observation, physical researches, and experiments.”†

The Academy’s memoirs and collection of prizes are replete with evidence of the importance they attached to, and the increase of knowledge derived from, experiments on living

*On the studies required for the medical profession, or lectures illustrative of various subjects in pathology and surgery, by Sir B. Brodie, London, 1846. P. 26.

†Memoires de l’Académie Royale de Chirurgie, 8vo. ed., Paris, 1774. Tome 1er, p.p. 10, 11 and xlv.

animals ; but the time at my disposal will only allow of two examples being quoted.

The pathology and treatment of injuries of the skull was at that date most imperfectly understood, and the Academy gave out as one of the subjects for competition :—
 “ To establish the theory of injuries of the head by Contre-coup, and the practical conclusions to be derived therefrom.”
 The prize was awarded to Saucerote’s Essay, based on literary research, clinical observations, and 21 experiments on living dogs.*

Amputation at the hip joint was only attempted after it was proved safe by vivisection.

“ The Academy is informed, says its Secretary General, that this operation has been performed with success on dogs.”†
 After relating the experimental proofs for that statement, the Secretary observes, “ These memorable trials should awaken the desire to do as much on the higher animals, and to encourage Army Surgeons, who have the greatest opportunity, to undertake this operation after battles ; for by it, probably, patients might be saved who are now left to their fate.” Experiments on brutes enlightened and nerved to action the practitioners of human surgery, and amputation at the hip joint, the direct outcome of vivisections, has resulted in saving many valuable lives, which otherwise must infallibly have perished. While Louis XV. and his court were patronizing the Academy, a few Englishmen dotted over the country, but chiefly in the provinces, were by their own unaided efforts leading up to a surgical revival of unequalled brilliancy. Alanson in Liverpool, White in Manchester,

**Memoire sur les contre-coups dans les lésions de la tête par M. Saucerote in mémoires des sujets proposés pour le prix de l’Acad. R. de Chir. Octavo Ed., Paris, 1778. Tome 10, p. 282 et seq.*

†*Memoires Ed. Cit. Tome 9, p.p. 24—25.*

Mynors in Birmingham, Hey in Leeds, Gooch in Norfolk, Cheselden and Pott in the metropolis, were unostentatiously doing their good and lasting work, while William Hunter laid the foundation of the experimental school, of which he and his brother John, Hewson and Cruikshank were the chief corner stones. This is not the time to endeavour to do justice to the relative merits of these masters, some of whom have been undeservedly obscured in general estimation by the overpowering merits of John Hunter. But I cannot pass Mr. Hewson's name without a brief reference. The principle of his working life was embodied in his favourite Baconian motto—" *Vere scire, est per causas scire.*"

Dying in 1774, at 36 years of age, from the effects of a dissection wound, William Hewson's chief labours were his experimental enquiries into the properties of the blood and the lymphatic system, and surgery is indebted to him for projecting the operation of paracentesis thoracis for pneumothorax. This he did on the basis of experiments on living dogs and rabbits.*

But the epoch maker was John Hunter. He perceived, grasped, and to a great extent worked out, on the basis of clinical observation and experiments on living animals, the idea of comparative pathology, based on the scheme of uniformity of construction and action of organised beings. I shall not stop to enquire if Hunter's operation for Aneurism was the direct result of any *one* experiment. His whole life's study was experimental, as every chapter in his writings, and hundreds of specimens in his museum incontrovertibly testify. His own work, vast and precise though

*The operation of paracentesis thoracis for air in the chest; with some remarks on the emphysema, and on wounds of the lungs in general, by Mr. William Hewson, reader of Anatomy. Communicated by Dr. Hunter, reced. June 15th, 1767. See Medical Observations and Enquiries by a Society of Physicians in London; 2nd edition, London, 1769, vol. III., p. 372, et seq.

it was, only represents the partial results of his method. It was the impetus which he gave to experimental enquiry, amongst his contemporaries and successors, that stamped his genius and inspired his school.

As an illustration of the fertility of a comparatively trifling experiment, take the division of the tendo achillis in dogs, which John Hunter practised, to study the process by which divided tendons are united. He was led to the research by rupture of his own tendo achillis, curiously enough while dancing, the very year of his election into the Royal Society. The experimental results so obtained led on to sub-cutaneous surgery, one of the most useful and life saving reforms in the art.*

No one laboured more successfully than did Antonio Scarpa to demonstrate and extend Hunter's teaching on Aneurism, and we are expressly told by Scarpa,† that he experimented on living dogs, sheep, oxen and horses, and on the information so obtained he founded his practice and teaching in the surgical wards and lecture theatre of the University of Pavia.

An ardent admirer of John Hunter's teaching, Abernethy put it to the hitherto untried test of ligaturing the iliac artery for aneurism of the femoral close to Poupart's ligament.‡

His patient died, but George Freer performed the operation with success, on a young Scotchman, at the Birmingham General Hospital, 19th September, 1806.§

*Palmer's edition of J. Hunter's works, vol. 1, p. 34. [Chirurgie vor 100 jarhen von Dr G. Fischer, Leipzig, 1876, p. 410—11.]

†I buoni successi degli sperimenti da me fatti sopra grossi animali, mf fanno animo a dirvi con asseveranza." De gli aneurismi opera del Cavaliere Antonio Scarpa per cura del Dottore Pietre Vannoni, Fireurge 1845, pp. 705—739 et seq.

‡Surgical Observations by John Abernethy, F.R.S., London, 1804, p. 210.

§ Observations on Aneurism and some diseases of the arteriel system, by George Freer 4to, Birmingham : Hunt and Lloyd, 1807.

Mr. Freer prepared himself for the great experiment on the human subject by tying the arteries of living dogs and horses; and he expressly tells us, that, at the most critical moment of tying James McDonald's iliac, he acted according to the experiments of Dr. Jones, who carried out and justified the most elaborate series of vivisections on the vascular system.

Mr. George Freer's monograph on Aneurism was illustrated by his pupil Mr. Joseph Hodgson, who rose to even greater repute, by his *Treatise on the diseases of arteries and veins, containing the Pathology and Treatment of Aneurism and Wounded Arteries*.‡ Following the example of his master, and of Scarpa and Hunter, Mr. Hodgson deemed it necessary to the saving of human life and pain, to enlighten his mind and train his hands by experiments on living brutes; and the identical method was pursued by Astley Cooper (*), Benjamin Travers (*), and William Lawrence (*).

Mr. Copland Hutchison in his *Practical Observations on Surgery* (†) has expressly recorded that the experiments on the arteries of living dogs and horses performed by Dr. Jones, Mr. Travers, and himself "suggested a valuable improvement in the mode of tying arteries for the cure of Aneurism, and justified a trial of it on the human subject."

Having incidentally alluded to the experimental *Treatise* of Dr. F. D. Jones "On the process employed by nature in suppressing the hemorrhage," &c.,§ a *Treatise* cited as a Text by all the great surgeons who succeeded him, I beg leave to

‡ London 1810.

(*) *Medico Chirurg. Transactions*, vol. 2, 3rd Ed., p. 258, op. ist vol. 4, p. 434, et seq. of cil, vol. 6, pp. 156 632 et seq.

(†) London, 1826, p. 352.

§ London : Longman, 1810.

quote the conclusion of Dr. Jones' preface, in defence of the practice of vivisection.

“He has only a few more words to say, addressed to men out of the pale of his profession, into whose hands this little book may fall, whose opinions he esteems and whose feelings he honours. He regrets the necessity of obtaining even this important knowledge by the sacrifice of brutes. But when we remember the incessant scourge of war which has followed man through all ages of his history,—not to mention the consequences of accident and disease,—it is not too much to assert, that thousands might have been, and may still be saved by a perfect knowledge of these subjects, which can only be directly obtained by experiments on brutes; indirectly and very slowly, by observations on the injured arteries of man, and even these cannot be made until he has fallen a sacrifice to the want of assistance, or to the imperfect knowledge of the Surgeon.”

Much yet remained to be done to obtain our present knowledge of hæmostatics. The time had now arrived for the English-speaking race beyond the Atlantic to lend their powerful aid; and by experimental researches on the use of animal ligatures, and on the tolerance of the animal tissues for metallic substances, the Americans grafted important facts on the common stock. Amussat revived the torsion of arteries, and Luigi Porta, the successor of Antonio Scarpa, instituted a great number of experiments on living animals to test the relative merits of ligature and torsion with a variety of materials and methods.*

Time renders it impossible to name all the other authors who have laboured in the same direction. It will be sufficient to

*Delle Alterazioni Patologiche delle Arterie per la Legatura e la Torsione. Esperienze ed Osservazioni di Luigi Porta, pp. 337, con tredici Tavole in Rame Milano, 1845.

state the result. Death from hemorrhage is now so rare, that I have only lost one patient from it in thirty years hospital and private practice, and many surgeons can doubtless relate a similar experience. To what have our patients owed their safety? Recall the state of things a century ago. Empiricism had had unbroken sway for ages, and countless human beings had bled to death, and suffered martyrdom, by the application of vitriol and the red hot iron, for the arrest of hemorrhage. But the secrets of nature were only discovered by the experimentalists, step by step, scalpel in hand. Living animals of all kinds were operated upon before the arrest of hemorrhage became a matter of quasi-mathematical certainty, and before the ablest men could attack the great arteries with success.

Vitally important as were the researches on living animals whence flowed the knowledge of blood pressure and velocity, —matters of the first importance to the surgeon—I am precluded entering upon them as they lie outside my immediate object of practical surgical illustration. Within it however, are the researches on blood transfusion, initiated in the second half of the 17th century by Dr. Lower, of Oxford, and the Honourable Robert Boyle.* They proved by vivisection before the Royal Society, what had indeed been imperfectly known to the Ancients, that an animal dying from loss of blood, may be revived by the transfusion of blood into its vessels from another animal. The practice had chequered success; and it was only after further appeal to vivisection, that faith in it was so far restored as to warrant new trials in the human subject.

In evidence of the manner in which the process of transfusion was revived, allow me to quote from Dr. James

*Philosophical Transactions of the Royal Society of London. Abridged Edition. London, 1829. Vol. 1, p. 128.

Blundell's "Experiments on the Transfusion of Blood," published in the ninth volume of the *Medico Chirurgical Transactions*.*

"A few months ago I was requested to visit a woman who was sinking under uterine hemorrhage. The discharge had stopped before my arrival, but her fate was decided, and notwithstanding every exertion of the medical attendants she died in the course of two hours. Reflecting on this melancholy scene I could not forbear considering that the patient might very probably have been saved by transfusion."

Dr. Blundell put the matter to the test of experiment, bled a dog to extreme fainting, and then injected into it six ounces of blood from another dog. "So sudden and complete was the resuscitation, that the animal seemed rather to awaken from sleep than arise from apparent death." Dr. Blundell made similar experiments, and his results having been substantially confirmed by many other enquirers in Europe and in America, transfusion has won its place amongst the resources of human surgery, for saving life in imminent peril. One of the most recent writers on the subject (Dr. Roussel), after fully acknowledging vivisections as the origin and warrant for transfusion of blood in man, relates fifty cases in which it was performed, with twenty-six complete recoveries and fourteen prolongations of life. In each of the patients the circumstances were extremely urgent, and all other means had failed.

Amongst the serious injuries to which the human body is liable, none afford a better illustration than do wounds of the intestines; of the advantages which have resulted from scientific experiments upon animals.

*1818, p. 56, et seq.

It was Shipton,* an English student of surgery, who in the early part of the last century made the following experiment. He cut away a portion, equal to two fingers breadth, of the ileum of a dog, connected the extremities by an uninterrupted suture, and closed the external wound. The dog recovered, but the experiment bore little if any fruit until it was taken up by Benjamin Travers, who, through his master Astley Cooper, was a direct descendant of John Hunter's school.

Mr. Travers, acknowledging his indebtedness to Shipton, instituted a series of experiments on living animals, and with the results so obtained, sought to reform the practise of human surgery. In his own words, "The benefit which has of late years resulted to practical surgery from a diligent study of those secret processes by which nature accomplishes her operations, furnishes, I conceive, an irresistible argument for the necessity of experiments on brutes. It is a weak objection, although urged by some respectable authorities, that the difference of economy in animals of different species does not warrant the application of similar conclusions. Granting the points of difference, it cannot be denied that the points of analogy in the general structure and functions of all animals of the same class, infinitely preponderate. And as human anatomy would have been yet very imperfect, and physiology altogether a conjectural science without the advantage which this analogy has afforded, it is reasonable to presume that the doctrines of pathology must admit of a similar mode of illustration."† The monograph in which Mr. Benjamin Travers recorded his observations was at once

*Observatio de Portione intestini Canis feliciter abscissâ, in *Phil. Transactions*, vol. xxii. 1703.

†An enquiry into the process of nature in repairing injuries of the intestines, illustrating the treatment of penetrating wounds and strangulated hernia. London, 1812. P. 3.

accepted as an authority. It led to immediate reform of surgical practise, and stimulated further experimental enquiries, which in their turn have borne the happiest results, in saving human life and misery. Mr. Travers' first and most illustrious pupil was his old master Sir Astley Cooper. He tells us, "I practised gastroraphy in consequence of the results of the following experiments (on living dogs). As far as a judgment can be formed from these experiments, it will be seen that this operation is in them both safe and effectual; for I have made the experiment of dividing the intestine, and afterwards sewing its extremities together and found it succeed."* Jobert (de Lamballe),† Samuel D. Gross,§ of Philadelphia, and Bouisson‡ of Montpellier, have repeated those researches, and the results have been so far confirmed and extended, that Shipton's original experiment, of removing a portion of the whole circumference of the alimentary canal, is now an established operation, against otherwise mortal disease in the human subject. So far as wounds of the intestine and the operation for hernia are concerned, the experimental researches referred to have materially reduced their dangers.

The fertile suggestiveness of young Shipton's experiment did not exhaust itself in the labours of Travers and his successors. When the anti-vivisectionists exclaim against the cruelty and uselessness of an English medical student excising a portion of a dog's intestine and proving its survival, I invite them to reflect, on the successful removal by the

*The anatomy and surgical treatment of abdominal hernia, by Sir Astley Cooper, 2nd Ed., by C. Aston Key, London, 1827, p. 51.

†Enteroplastie ou Autoplastie du Canal Intestinal. *Traité de Chirurgie Plastique* par A. J. Jobert (de Lamballe). Paris, 1849, T. 2 p. 80 et seq.

§A System of Surgery, by S. D. Gross, London and Philadelphia, 1872. Vol. II, p. 663.

‡Tribut à la Chirurgie ou mémoires sur divers sujets de cette science par E. F. Bouisson, Paris, Montpellier, T. 1er p. 139, et seq.

knife of the upper extremity of the human stomach blocked with cancer; a disease which, in that situation at any rate, has never been proved curable by other means. Before attacking it, Péan, of Paris, operated experimentally on brutes, then on man. His patient died; but Billroth, and his assistant Wölfler, of Vienna, succeeded. My good friend Nicolaysen, of Christiania, followed; but in spite of his well-known skill, his patient died in fifteen hours. Nothing daunted Czerny, of Heidelberg, returned to the charge. His patient had been greatly reduced in weight by ten weeks constant vomiting. The enormously distended stomach reached actually to the pubes, and contained a tumour near the pylorus as large as a child's fist. Czerny opened the abdomen, then made an exploratory incision into the stomach, and removed the cancer. The operation lasted more than two hours. The wound healed without a sign of inflammation. There was no vomiting—no pain. The patient took some soup on the second day, meat on the fifth, got up the twentieth day, gained eleven pounds in weight the next fortnight, and then returned to his usual occupations.* Warranting, as such cases do, the placing of cancer of the stomach amongst diseases curable by the knife, do they not also justify the vivisection of dogs by Shipton and Travers, who, by their experiments, laid the first scientific foundation of intra-abdominal surgery.

Even the brave Liston in 1840 denounced the surgeon who opened the abdomen, in quest of tumours, in unsparing terms like these, "The result has been such as to render the perpetrator indictable for culpable homicide, and to qualify for such punishment as his rash and reckless conduct richly deserved." Had Liston been spared to know the triumphs

* Transactions of the London International Medical Congress, 1881, vol. II, p 232-3

achieved by persistent and well-conducted scientific experiment, he would have been one of the loudest in their praise. He was a great surgeon, and as most great surgeons have been, was a warm and tender-hearted and determined fellow, endowed with resource to forge his way, in spite of petty jealousy,—the unconscious homage of impotence to power.

No operations are a source of greater regret to surgeons than amputations of the limbs. No advance has been more welcome than the substitution for them of excisions. The mortality attending these is very slight, and experience has demonstrated that a shattered or diseased joint may be resected, and a very useful limb retained. The clinical experience which has brought about these results has been enlightened and powerfully assisted by vivisection. Mr. Syme, to whom this department of surgery is under special obligations, read a paper on the 6th of March, 1837, before the Royal Society of Edinburgh, “On the power of the periosteum to produce new bone.”† The question which he proposed to consider was, “Whether the periosteum, or membrane that covers the surface of the bones, possesses the power of forming new osseous substance, independently of any assistance from the bone itself?”

Duhamel had answered in the affirmative, nearly a century before, on the basis of vivisections and other experiments, but Haller contested the matter, and professional opinions remained divided in regard to the ossific power of the periosteum. The point in dispute being not merely a matter of curiosity, but one of great practical importance, Mr. Syme thought it very advisable that the truth should be

† Contributions to the Pathology and Practice of Surgery, by James Syme, F.R.S.E. Edinburgh, 1848, p 30, et seq

ascertained. Clinical experience appeared to him to bear out the experimental results of the French naturalist, but with the view of settling the matter, he resected the bones of a number of living dogs, with and without the periosteum. The evidence thus obtained put beyond all question the power of the periosteum to form new bone, independently of any assistance from the old one. Still the subperiosteal method of resection made but little way, in spite of abundant clinical experience. Another and still more laborious series of vivisections was required, before the problem was definitely solved. These results achieved by Ollier of Lyons, were published in 1867 in two volumes, under the title "Experimental and Clinical Treatise on the Regeneration of Bones and on the Artificial Production of Osseous Tissue."* The first volume is experimental, the second clinical. Ollier dedicated them to Claude Bernard and Velpeau in these words, "When I left experimental physiology for the practice of surgery, I wished to tread the paths you have marked out, the one in determining the methods of scientific medicine, the other, in showing, during forty years, the fertility of its applications." In his introduction (p. 2), Ollier lays down that "experiments on living animals are of the greatest utility to surgery."

Chassaignac's invention of the *écraseur* has proved of the utmost utility to operating Surgeons. How it was perfected, and how the rules for its employment were determined, is best told in a condensed translation of his own words.† "Physiological experiments concerning linear crushing (*écrasement linéaire*).

* *Traité Expérimental et Clinique de la Régénération des Os et de la Production artificielle du Tissu osseux*, par L. Ollier. Paris 1867.

† *Traité Unique et Pratique des Opérations Chirurgicales*, par E. Chassaignac. Paris 1861. T. 1er p. 75, et seq. See also *Traité de l'Ecrasement linéaire Nouvelle Méthode pour prévenir l'Effusion du Sang dans les Opérations Chirurgicales*, par M. E. Chassaignac. Paris 1856.

“In the course of the winter, 1854, I made a series of experiments on living animals in the laboratory of Mr. Fluorens at the Jardin des Plantes. The crushing instrument applied to the dog’s tongue, completely divided it in its thickest part.

“In experiments on the lingual tissue of living animals, we obtained this constant result,—when the crushing was conducted slowly, the solution of continuity was dry, and there was no hemorrhage, neither primary nor secondary, and healing was rapid. . . . But when the crushing was done quickly, hemorrhage occurred.

“In experiments performed at the Grenelle slaughter-house with Veterinary-Surgeon Charlier, the 1st October, 1854, we found that the carotid artery of a sheep could be divided without hemorrhage.

“Section of the ovarian arteries of a cow, by the same same process, yielded the same results.

“It was very important to know what was the effect of linear crushing on the sensibility of living tissues; theory pointed to intolerable pains, experience belied them. After the first efforts of the pinching, produced by the pressure of the nerves in the instrument, the strangled part swells and loses all sensibility.”

These results have been constantly verified in operations on the human subject. In obtaining that evidence, pain was doubtless inflicted on many brutes; but balance against that the saving of pain and life which has resulted to countless human beings; for, since Chassaignac perfected it, the *écraseur* has been constantly in use by surgeons in all parts of the world.

This recital of the beneficial influence of vivisections on the improvement effected in surgical operations and

instruments, admits of very great extension ; but it may be useful and interesting, at this stage, briefly to review the influence of the school of experiment generally, and of scientific experiments on living animals in particular, on the progress of surgery through the education of some of its leaders.

Surgery was only a tangled mass of empirical knowledge, handed down by tradition, until it came to be studied as a branch, and with the aid, of other departments of experimental science.

Reverting to our date of 1750, the quarter of a century which preceded and followed was singularly productive of naturalists and surgeons, physicists, chemists and astronomers, assisting each other and advancing on the same lines of observations and inductions.

In 1728 John Hunter and Joseph Black were born. In the next five years followed Lazzaro Spallanzani (1729) Henry Cavendish and Joseph Priestley (1733). Lavoisier saw the light in 1743, and in the succeeding lustre Dessault (1744), Volta (1745), Scarpa (1747), Jenner and La Place (1749). The five years (1764—69) were even more prolific, with Abernethy (1764), Larrey (1766), Astley Cooper, Humboldt and Cuvier (1769),—the epoch year which also gave the world Napoleon and Wellington, Brunel and James Watt. Only three years later commenced the brief but brilliant career of Xavier Bichât, to be followed closely by an accession of some of the world's greatest physiologists, surgeons and physicists, to wit Charles Bell (1774), Delpeche and Dupuytren (1774), Humphrey Davy (1778) and Berzelius (1779). One and all were original observers, working out the results of experiments according to the rules of the inductive philosophy. Everyone of the

great surgeons named did some of his best work, in widening and solidifying the foundations and raising the edifice of human surgery, by experiments on living animals. The one surgeon amongst them who did the least in that direction, illustrates in a particular manner the great value of such research. To Charles Bell, experiments on living animals were specially abhorrent; yet, without them, it would have been impossible for him to discover that sensory and motor impulses travel along different routes of spinal nerves, and that ganglions are not intended to cut off sensation as was universally held up to his day. To those who doubt the influence of vivisections on Charles Bell, I would suggest the reading of only eight pages of his numerous works. From page 29 to 36 inclusive of the introduction to "The Nervous System of the Human Body," embracing the papers delivered by Charles Bell to the Royal Society on the subject of the nerves* is a succinct account of the substance of his chief discoveries, and of the processes by which he arrived at them. Vivisections were absolutely indispensable to him, and he performed them. Had he possessed sufficient firmness of resolve to subjugate his emotions to his reason, he would have experimented more, and speculated less. So doing he could not have failed to forestall Marshall Hall, and to have achieved a position amongst discoverers not inferior to William Harvey's.†

Through Everard Home and Dr. Baillie, John Abernethy, Astley Cooper and William Lawrence,—through the Hunterian Museum and its worthy conservator and commentator Richard Owen, the influence of John Hunter's work has come down, by unbroken links, to the first Sir Benjamin

*London : Longman's, 1830.

†See Dr. Michael Foster's address on Physiology to Int. Med. Con. Transactions, London 1881, vol. 1, page 207 et. seq.

Brodie and Sir James Paget, the leaders of British surgery for the last half century. If you want to know what Brodie thought of scientific experiments on living animals in laying the foundation of a Surgeon's knowledge, read his physiological researches, which, so late as 1851, when full of wisdom and honours, he deemed it worth while to collect, in the original papers published forty years previously in the *Philosophical Transactions*. If Sir James Paget's recent article in the *Nineteenth Century* leave you in any doubt as to his opinion on the matter in question, be good enough to read his *Lectures on Surgical Pathology*, edited by Professor Turner of Edinburgh.

If you want to know what Germany thinks on the subject, read Professor Virchow's address before the late International Medical Congress ("Ueber den werth des Pathologischen Experiments"). With illustrious individual exceptions, the Germans were backward in the race for Medical fame. They had nothing to compare with the French Academy of Surgery. Our Pre-Hunterian Surgeons were incomparably superior to their Pre-Hallerians. They had no match for Morgagni and his pupil Scarpa. But once they perceived the great truth, once they set out on the high road of experiment, their impetus was overwhelming and their conquests have brought them to the fore all along the line.

Irony of fate ! That a countryman of Stahl and Hahnemann should, in the year of grace 1881, have had to defend before the greatest of all known Medical assemblies, the value of scientific experiments on living animals in the fatherland of William Harvey and the Hunters, standing as the great German scientist did, addressing his memorable audience, within a few yards of the Old Windmill Street School of glorious experimental memory. The contrast could scarcely

be more startling if to the countrymen of Hampden, of Pitt, and of Charles James Fox, a Napoleon at Westminster defended the right of free speech, against the paralyzing influence of the French clôture.

When I undertook to deliver this address, I did not merely propose to recall historical evidence of the saving of pain and life to man, which experiments on brutes have exercised on human surgery. I felt deeply, as the vast majority of the medical profession do, all the world over, the straight in which our colleagues are placed, who are charged with the study and teaching of physiology in Great Britain. As a group, they are in our front scientific rank, for merit and responsibility. The knowledge which they possess and promote, is essential to all who practice our difficult profession. Their teaching is the very foundation of the training of the pupils who enter our surgical wards.

British Physiologists stand before the country accused of cruelty, dogged by spies, and liable to criminal prosecution for doing that, which some of the wisest and best men of the world have done for the lasting benefit and honour of mankind. It is only right that we who have benefited so largely, and yet hope so much from their labours, should stand forward, and take our place by their side with complete solidarity.

What are many of the operations which every surgeon performs but experimental? Take the every day case of a strangulated hernia. Once diagnosed, we tell the patient that the bowel is tied down by a string, which will have to be cut if the obstruction cannot be relieved under ether. Patient and friends say "we are in your hands, do as you think best."

The painless sleep produced, we apply the taxis; that failing, we divide the skin and subjacent structures, and in the absence of special contra-indications, strive to reduce without opening the sac. We may still fail, open the sac and fail again. Then gently turn out the contents, and within a mass of omentum find a knuckle of blue red bowel. Most carefully, the stricture is divided, the contents returned, and the patient allowed to wake, perhaps to ask for the first question, "when are you going to begin?" and to be told in reply that all is safely over; and to be assured of recovery, which, all cutting surgical operations included, surgeons can now guarantee with an average mortality of about two per cent.

If anyone try to conceive the thousands upon thousands of human lives saved by surgical operation, he must remember that the computation is not one of simple addition. An unknown quantity has to be discovered, and allowed for; the hundreds and hundreds of lives that are shortened by the surgeon's knife. Where is the operator of large experience who cannot recall lives that, but for his intervention, might have been prolonged for months or years? Once a disease is diagnosed, which in all human probability must prove fatal if left to its course, and which internal remedies cannot relieve, if a chance of complete recovery be held out by the surgeon, how anxious for it, in the majority of instances, are patients and friends.

Every precaution is taken, every wise counsel sought, all possible skill employed, and yet how often within a few hours the undertaker follows the surgeon. Is not that an awful yet inevitable human vivisection? How many such results have been saved by the experience acquired in the vivisection of brutes?

Some persons fear that scientific experiments on living animals may brutalize, by hardening the experimenter. They would think otherwise, if they knew more of physiology and psychology. As the power for hate, jealousy, and lust, increases with exercise, so by the Divine Providence do the best and noblest aspirations of our nature. None more so than does the power of sympathy with those who suffer.

Natural endowments, sense of duty, severity of discipline may enable a strong man to seem unmoved amidst scenes of the direst woe. But if interrogated, he will often answer in the heroic anguish of Dante's Ugolino,

"Io non piangeva ; si dentro impietrai."

Yet, the surgeons who are trusted with such responsible, nay holy, work, and their brother physiologists who are gentlemen at least as able, as cultured, and as kindly as themselves, are not to be trusted with the vivisection of a rat or a toad, for the purpose of discovering something to prevent the vivisection of a man or woman, or to ensure its success when it has become inevitable.

If to-morrow I saw a case the parallel of Czerny's, and resolved to excise a man's pylorus, the poor creature, threatened with otherwise certain death, might grasp at the remotest chance of life. If I operated, and he died in a few hours, death would be looked upon as a natural result after the great risk incurred, and no one would say anything, assuming of course that I had used all reasonable care and diligence. But if before operating on that man, I resolved to gain experience on Czerny's "Zwei reihige Naht" (double row suture), and put a brute animal to sleep, to try it on his pylorus for perfection and safety in operating on the man, I should be liable to be brought up at a Police Court under a charge of cruelty to animals.

All I can say is, that under those circumstances, I should not hesitate an instant as to my course of action. I should sacrifice the brute in the interests of my patient, and leave the Act of Parliament to its official custodians.

Lest it might be supposed that I have put an extreme case, let me remind you of the fact, that Professor Fraser, of Edinburgh, and Dr. Lauder Brunton, of London, two of the foremost authorities on therapeutics in Great Britain and in Europe, have been stopped in their experimental enquiries by the formalities of the necessary legal license. Nay more, in the still pending case of aconite poisoning, where a man is charged with murder, the very experts for the Crown had to wait for days, before they could obtain permission to inject a drop of the suspected poison under a mouse's skin.

Let us have no equivocation. If the law is to be administered in that spirit, there is an end to the British school of experimental and comparative physiology, pathology, and therapeutics, on the lines of investigation which give the greatest hope for the progress of human medicine and surgery.

Is a compromise impossible?

As a profession who have done so much for the public, whose labours are so ill requited, and who are now exposed to such undeserved contumely, we have a grievance, and a very grave one. But are we blameless? Has there been no excess of zeal, no indiscretion on our side?

Zeal, notwithstanding Talleyrand's protest, is an essential in all great work; but like other virtues, it is unhappily apt to develop into a vice, when indefinitely produced. But assuming, nay admitting, errors, are we the only profession chargeable with mistaken zeal? Is the spirit of the old

Puritan quite dead? Is the story of Calvin and Servetus forgotten? Is the "Index Expurgatorius," in spirit if not in letter, a Vatican monopoly? Is it all charity under and around the Ecclesiastical Titles Act? Are the far distant gaols, with the five hundred unheard suspects, no proof of mistaken statecraft?

The love of animals, which is one of the prime movers in the breasts of those who oppose vivisection, is deeply to be cherished. As Englishmen we yield for it to no nation. The alleged horrors of Alfort and of the Florence laboratory are not practised in Great Britain. We hold scientific experiments on animals are indispensable. Let us reassure all kindly persons, by giving every possible guarantee that only essential experiments shall be performed, and in the most humane manner possible. Vivisection might be restricted to licensed public institutions, such as medical schools or other scientific colleges, and then under the cognisance of their governing bodies. If in something like this spirit a truce be agreed upon, and the Act temperately administered, I feel quite confident that the medical profession will act in the matter, in the same spirit of benevolence and honour in which they discharge all their public duties. But, if spies are to track every scientific enquirer, and such prosecutions, as the recent one of Doctor Ferrier, to be renewed, I would venture to make an observation. Laws which are too stringent and uncompromising inspire their own violation. Smugglers are the outcome of oppressive fiscal laws, as body-snatchers were of prohibited human dissection.

But there is yet another class of objectors. Those worthy persons who believe that by the performance of scientific experiments, especially on animals, men grow materialists and

infidels. The feeling has my deepest and most respectful sympathies, but I do not share the alarm which inspires it.

True it is, unhappily, that many advanced thinkers in science and in politics, seem to rebel against the Gospel's yokedom, strangers to the glorious freedom enjoyable under its light and easy discipline. Why it should be so we cannot say ; but all who believe that God is true and infinitely good and powerful, can have no fear, only hope, from the revelations of His wisdom and His mercy.

Is it not possible to lavish too much sympathy on Magdalenes, murderers, and fools, and to forget the special trials of men and women endowed with aspiring intellects and racking passions, with nerves strung, and hearts thumping, to the utmost of physical endurance ?

Is the fault all with the scientists ?

The preachers were pre-eminent as men of brains and force of character in the most glorious days of Gospel conquest, and in the days when the Talmud was written, and when Realdus Columbus vivisected for the discovery of the pulmonary circulation, at the Court of Pope Paul IV. (the learned Carafa), lavish patron of men of letters and science, "*Literis erat egregiè exultus, et Graecè Latineque scientissimus. . . . eloquentia fuit incredibili.*"

Soldiers of the Cross, fight for it and you will find thousands of recruits in our ranks ; but if you attempt to stem the advance of Science on the high road of the experimental philosophy, we bid you, Halt ! the attempt is as hopeless as Canute's to roll back the tide.

Are you dispirited because your leaders seem to achieve so little, and those of Science so much ? We entreat you ; have faith ! The great Gospel will be revealed, independently of your

and our shortcomings. Try some psychological blood transfusion in some of your leaders,—enlist a few more Bishops Fraser and Magee,—more Senior Wranglers like Henry of Worcester,—try an order of preachers who shall be able to illustrate the doctrine of the correlation of forces as a link in the chain of evidence of the Unity of Creation,—men who shall be able to preach a course of sermons on the second chapter of Genesis, and the eighth chapter of St. Paul's Epistle to the Romans,—men of large tender hearts and big cultured brains. Such men might not find it so very difficult to reconcile science with religion, if called to comfort a sorrowing experimenter. It might possibly not be easy to console him with the Bull "Ineffabilis Deus," the Apocalypse, or the Athanasian Creed; but the Sermon on the Mount, or the 23rd Psalm, would stand a better chance.

If a downcast man of science beaten in the struggle, sick, poor, and lonely, were very doubting, cold, unsympathetic, and inarticulate under the paralyzing influence of his pent-up feelings, the abstract assertion of dogmatic truth might not find a ready listener. Then let a spiritual adviser arrange for bringing to the poor man's ear, from a Music Temple, a telephone singing in the accents of a Mozart, an Auber, or a Rossini, John Henry Newman's hymn,—

Lead, kindly Light, amid the encircling gloom,
 Lead Thou me on;
 The night is dark, and I am far from home,
 Lead Thou me on.
 Keep thou my feet; I do not ask to see
 The distant scene, one step enough for me.

I was not ever thus, nor prayed that thou
 Shouldst lead me on;
 I loved to choose and see my path, but now
 Lead thou me on.
 I loved the garish day, and, spite of fears,
 Pride ruled my will: remember not past years.

So long Thy power hath blest me, sure it still
 Will lead me on
 O'er moor and fen, o'er crag and torrent, till
 The night is gone.
 And with the morn those angel faces smile,
 Which I have loved long since, and lost awhile.

When told that such are some of the good and glorious means, by which God reveals Himself through His servants, the priests the musicians and the men of science, the poor experimenter's nerve tension might relax, his tears flow, and the way be opened for those higher mysteries, which bring that peace which passeth all understanding. He could then perceive how and why in religion, as in science ALL is vouchsafed to no one man. Each must

 not ask to see
 The distant scene, one step enough for me.

In the scientific laboratory and in the cloister, on the Rocky Mountains and the Jungfrau,—on Olivet and Calvary, "*Step by Step*" is the marching order.



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